

**Modulhandbuch für
Production Systems Engineering (M.Sc.)**

Stand: Juni 2014

Content / Inhaltsverzeichnis

Module Handbook: Production Systems Engineering (M.Sc.)	3
Prüfungsordnungsbeschreibung: Production Systems Engineering (M.Sc.)	3
Compulsory Courses	4
Module (Modul): Manufacturing Technology II	4
Module (Modul): Production Management B	7
Module (Modul): Welding and Joining Technologies	10
Module (Modul): Quality Management	13
Module (Modul): German Language Course	16
Module (Modul): Master Thesis	19
Module (Modul): Gear and Transmission Technology	21
Module (Modul): Mechatronics and Control Techniques for Production Plants	24
Elective Courses.....	27
Module (Modul): Control Engineering.....	27
Module (Modul): Industrial Logistics	30
Module (Modul): Multibody Dynamics	33
Module (Modul): Process Chains for Replication of complex optical Elements	37
Module (Modul): Production Metrology	40
Module (Modul): Factory Planning.....	43
Module (Modul): Modeling, Model Reduction and Simulation in Laser Processing I	46
Module (Modul): Modeling, Model Reduction and Simulation in Laser Processing II	49
Module (Modul): Advanced Software Engineering	53
Module (Modul): Tribology	56
Module (Modul): Machine Design Process.....	59

Module Handbook: Production Systems Engineering (M.Sc.)

Prüfungsordnungsbeschreibung: Production Systems Engineering (M.Sc.)

Title Titel	Production Systems Engineering (M.Sc.)
Sub-Title Untertitel	Production Systems Engineering

Compulsory Courses

Module (Modul): Manufacturing Technology II

Module Modulbezeichnung	Manufacturing Technology II
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	MT II
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	1
Person in Charge Modulverantwortliche	Klocke, Fritz
Lecturer Dozenten	Klocke, Fritz
Language Sprache	English Englisch
Assignment to the curriculum Zuordnung zum Curriculum	Compulsory Module Pflichtmodul
Teaching form Lehrformen	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload Arbeitsaufwand	Total 180h, Contact hours 60h, Self-study 120h Gesamt 180 h, Kontaktzeit 60 h, Selbststudium 120 h
Lecture hours Kontaktzeit (SWS)	4
ECTS-Credit Points (CP) Kreditpunkte	6
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	None
Learning Objectives Angestrebte Lernergebnisse	<p>Manufacturing Technology II</p> <p>After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding:</u> <i>Students</i></p> <ul style="list-style-type: none"> a) have an extended understanding in technologically comprehensive topics like material science and tribology. b) know and understand the mechanisms to improve the performance of powder metallurgical, cutting, forming and hybrid processes. <p><u>Abilities / Skills:</u> <i>Students</i></p> <ul style="list-style-type: none"> a) apply this knowledge properly and are able to assess manufacturing processes with regard to near surface damages and functional surfaces.

	b) are able to evaluate processes by calculation of key figures for productivity, profitability and reliability und thus are able to propose solutions. <u>Competences:</u> <i>Students</i> a) critically analyze company decisions with technological background and are able to communicate the assessments also to a non-specialist audience. b) are familiar with the latest trends in seminal branches like optical components, mobility and tool making.					
Content Inhalt	Manufacturing Technology II <ul style="list-style-type: none"> • Metal-based Materials • Tool Materials • Powder Metallurgy • Tribology • Near Surface Damages and Functional Surfaces • High-Speed Machining • Bulk and Sheet Metal Forming • Computer-aided Technology Planning • Hybrid Manufacturing Methods • Productivity and Profitability • Manufacturing of Optical Components • Manufacturing of Components for Mobility • Manufacturing Methods for Toolmaking 					
Media Medienform	e-Learning L ² P, Power Point					
Literature Literatur						
Lectures / Examinations						
Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kreditpunkte	Workload Arbeitsaufwand (h)	Lecture H. Kontaktzeit (h)	Self-study Selbststudium (h)	Duration of Exam Prüfungsdauer (min)
Examination (Prüfung): Manufacturing Technology	MSPSE	6	0	0	0	90
Lecture (Vorlesung): Manufacturing Technology	MSPSE	0	90	30	60	
Exercise (Übung): Manufacturing Technology	MSPSE	0	90	30	60	
Teaching Unit / Examinations: Examination Manufacturing Technology II						
Studien-/Prüfungsleistung: Prüfung Manufacturing Technology II						
Title Titel	Examination Manufacturing Technology II Prüfung Manufacturing Technology II					
Sub-title Untertitel	MT II					
Semester Studiensemester	1					
Connection to the curriculum Curriculare Verankerung	Compulsory module (variable to the semester) Semestervariable Pflichtleistung					
Connection to the curriculum Curriculare Verankerung	Compulsory module (variable to the semester) Semestervariable Pflichtleistung					
Teaching Unit / Examinations: Lecture Manufacturing Technology II						
Studien-/Prüfungsleistung: Vorlesung Manufacturing Technology II						

Title Titel	Lecture Manufacturing Technology II Vorlesung Manufacturing Technology II
Sub-title Untertitel	V MT II
Semester Studiensemester	1
Connection to the curriculum Curriculare Verankerung	Compulsory module (variable to the semester) Semestervariable Pflichtleistung
Teaching Unit / Examinations: Exercise Manufacturing Technology II Studien-/Prüfungsleistung: Übung Manufacturing Technology II	
Title Titel	Exercise Manufacturing Technology II Übung Manufacturing Technology II
Sub-title Untertitel	Ü MT II
Semester Studiensemester	1
Connection to the curriculum Curriculare Verankerung	Compulsory module (variable to the semester) Semestervariable Pflichtleistung

Module (Modul): Production Management B

Module Modulbezeichnung	Production Management B
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	PM
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	1
Person in Charge Modulverantwortliche	Schuh, Günther
Lecturer Dozenten	Schuh, Günther
Language Sprache	English Englisch
Assignment to the curriculum Zuordnung zum Curriculum	Compulsory Module Pflichtmodul
Teaching form Lehrformen	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload Arbeitsaufwand	Total 150h, Contact hours 60h, Self-study 90h Gesamt 150 h, Kontaktzeit 60 h, Selbststudium 90 h
Lecture hours Kontaktzeit (SWS)	4
ECTS-Credit Points (CP) Kreditpunkte	5
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	none
Learning Objectives Angestrebte Lernergebnisse	<p>Production Management B</p> <p>After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding:</u> <i>Students</i></p> <ul style="list-style-type: none"> a) know and understand particular aspects of the domains design, process planning, production as well as program planning and investment planning; b) understand the usefulness of modern planning methods, with emphasis on the application of computers (CAD, CAP, CAM etc.; c) Practical examples offer the possibility to understand the boundary conditions in daily business and give the students an advanced and comprehensive basis to reflect advantages and disadvantages of the discussed systems <p><u>Abilities / Skills:</u> <i>Students</i></p> <ul style="list-style-type: none"> a) analyse the structure of enterprise resources, make comparisons and give recommendations according to the results of the analysis

Content Inhalt	Production Management B					
	<ul style="list-style-type: none"> • IT in Production Management • Customer Relations Management • Enterprise Resource Planning I • Enterprise Resource Planning II • Enterprise Resource Planning III • Supply Chain Management I • Supply Chain Management II • Product Lifecycle Management I • Product Lifecycle Management II • Product Lifecycle Management III • Digital Plant Planning and Simulation • Business Engineering - Method of selecting IT-Systems 					
Media Medienform	e-Learning L ² P, Power Point					
Literature Literatur						
Lectures / Examinations Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kredit- punkte	Workload Arbeits- aufwand (h)	Lecture H. Kontakt- zeit (h)	Self-study Selbst- studium (h)	Duration of Exam Prüfungs- dauer (min)
Examination (Prüfung): Production Management B	MSPSE	5	0	0	0	90
Lecture (Vorlesung): Production Management B	MSPSE	0	75	30	45	
Exercise (Übung): Production Management B	MSPSE	0	75	30	45	
Teaching Unit / Examinations: Examination Production Management B Studien-/Prüfungsleistung: Prüfung Production Management B						
Title Titel	Examination Production Management B Prüfung Production Management B					
Sub-title Untertitel	PM B					
Semester Studiensemester	1					
Connection to the curriculum Curriculare Verankerung	Compulsory module (variable to the semester) Semestervariable Pflichtleistung					
Teaching Unit / Examinations: Lecture Production Management B Studien-/Prüfungsleistung: Vorlesung Production Management B						
Title Titel	Lecture Production Management B Vorlesung Production Management B					
Sub-title Untertitel	V PM B					
Semester Studiensemester	1					
Connection to the curriculum Curriculare Verankerung	Compulsory module (variable to the semester) Semestervariable Pflichtleistung					
Teaching Unit / Examinations: Exercise Production Management B Studien-/Prüfungsleistung: Übung Production Management B						
Title	Exercise Production Management B					

Titel	Übung Production Management B
Sub-title Untertitel	Ü PM B
Semester Studiensemester	2
Connection to the curriculum Curriculare Verankerung	Compulsory module (variable to the semester) Semestervariable Pflichtleistung

Module (Modul): Welding and Joining Technologies

Module Modulbezeichnung	Welding and Joining Technologies
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	WJT
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	1
Person in Charge Modulverantwortliche	Reisgen, Uwe
Lecturer Dozenten	Reisgen, Uwe
Language Sprache	English Englisch
Assignment to the curriculum Zuordnung zum Curriculum	Compulsory Module Pflichtmodul
Teaching form Lehrformen	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload Arbeitsaufwand	Total 180h, Contact hours 60h, Self-study 120h Gesamt 180 h, Kontaktzeit 60 h, Selbststudium 120 h
Lecture hours Kontaktzeit (SWS)	4
ECTS-Credit Points (CP) Kreditpunkte	6
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	-none-
Learning Objectives Angestrebte Lernergebnisse	<p>Welding and Joining Technologies</p> <p>Welding is an interdisciplinary technology. All fields of industrial manufacturing require the joining of individual parts to functional groups. Many welding and cutting technologies are applicable for this purpose. After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding:</u> <i>Students</i></p> <p>a) understand the main welding technologies and know how to critically review the shown welding technologies</p> <p><u>Abilities / Skills:</u> <i>Students</i></p> <p>a) are capable to select the suitable welding technologies for a welding task and to substantiate the selection by specifying the advantages and the disadvantages of the individual methods</p>

Content Inhalt	Welding and Joining Technologies <ul style="list-style-type: none"> • Introduction • Welding of steel • Gas Fusion Welding • Manual Metal Arc Welding • Submerged Arc Welding • TIG Welding • Plasma Welding • MIG Welding • Electro Gas Welding • Electro Slag Welding • Pressure Welding • Resistance Welding • Electron Beam Welding • Laser Beam Welding • Special Processes • Mechanisation / Automation • Sensor Technology • Brazing • Mechanical Joining / Adhesive Bonding • Design and Calculation 					
Media Medienform	e-Learning L ² P, Power Point					
Literature Literatur						
Lectures / Examinations Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kredit- punkte	Workload Arbeits- aufwand (h)	Lecture H. Kontakt- zeit (h)	Self-study Selbst- studium (h)	Duration of Exam Prüfungs- dauer (min)
Examination (Prüfung): Welding and Joining Technologies	MSCAME- 2103.a/12	6	0	0	0	120
Lecture (Vorlesung): Welding and Joining Technologies	MSCAME- 2103.b/12	0	90	30	60	
Exercise (Übung): Welding and Joining Technologies	MSCAME- 2103.c/12	0	90	30	60	
Teaching Unit / Examinations: Examination Welding and Joining Technologies Studien-/Prüfungsleistung: Prüfung Welding and Joining Technologies						
Title Titel	Examination Welding and Joining Technologies Prüfung Welding and Joining Technologies					
Sub-title Untertitel	WJT					
Semester Studiensemester	1					
Connection to the curriculum Curriculare Verankerung	Compulsory module Semestervariable Wahlleistung					
Teaching Unit / Examinations: Lecture Welding and Joining Technologies Studien-/Prüfungsleistung: Vorlesung Welding and Joining Technologies						

Title Titel	Lecture Welding and Joining Technologies Vorlesung Welding and Joining Technologies
Sub-title Untertitel	V WJT
Semester Studiensemester	1
Connection to the curriculum Curriculare Verankerung	Compulsory module Semestervariable Wahlleistung
Teaching Unit / Examinations: Exercise Welding and Joining Technologies Studien-/Prüfungsleistung: Übung Welding and Joining Technologies	
Title Titel	Exercise Welding and Joining Technologies Übung Welding and Joining Technologies
Sub-title Untertitel	Ü WJT
Semester Studiensemester	1
Connection to the curriculum Curriculare Verankerung	Compulsory module Semestervariable Wahlleistung

Module (Modul): Quality Management

Module Modulbezeichnung	Quality Management
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	QM
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	2
Person in Charge Modulverantwortliche	Schmitt, Robert
Lecturer Dozenten	Schmitt, Robert
Language Sprache	English Englisch
Assignment to the curriculum Zuordnung zum Curriculum	Compulsory Module Pflichtmodul
Teaching form Lehrformen	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload Arbeitsaufwand	Total 180h, Contact hours 60h, Self-study 120h Gesamt 180 h, Kontaktzeit 60 h, Selbststudium 120 h
Lecture hours Kontaktzeit (SWS)	4
ECTS-Credit Points (CP) Kreditpunkte	6
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	-none
Learning Objectives Angestrebte Lernergebnisse	<p>Quality Management</p> <p>Due to the growing importance of quality assurance in industrial production and economy, the lecture "Quality Management" was initiated at the Faculty of Production Engineering.</p> <p>Quality issues of industrial applications and necessary underlying theories are emphasized during the course of this lecture. It is the main aim of this lecture to present the students with the abstract concept of <i>quality</i>, its importance and social relevance, possible organizational forms of quality systems and relating quality management methods and tools.</p> <p>During the turn, a broader perspective can also be given via discussions about more advanced and detailed topics such as strategic quality planning, balancing quality costs and quality related legal questions.</p> <p>After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding: The students...</u></p> <p><i>Students</i></p> <ol style="list-style-type: none"> understand the abstract concept of quality; know the standards (norms);

	<p>c) understand main quality issues of industrial applications; d) know necessary underlying management theories; e) understand essential quality tools, their function, the benefit and their interdependence; f) know the organization of management systems; g) know the organization of quality systems</p> <p><u>Abilities / Skills: The students...</u> <i>Students</i></p> <p>a) have deepened their statistic knowledge; b) have improved their computer skills; c) have improved their economic thinking; d) analyse problematic quality issues: e) apply tools to contexts</p> <p><u>Competencies: The students...</u> <i>Students</i></p> <p>a) critically assess topics such as quality planning, quality costs and quality legal questions via discussions; b) critically reflect approaches, methods and guiding principles while communicating their opinions</p>
<p>Content Inhalt</p>	<p>Quality Management</p> <p>01 Introduction:</p> <ul style="list-style-type: none"> • The concept of <i>quality</i>, Quality Management structures, poor quality and defects, Deming-Chain, quality improvement and failure prevention <p>02 Normative QM Systems:</p> <ul style="list-style-type: none"> • Total Quality Management (TQM), normative quality management standards, implementation of quality management systems, auditing and certification concepts <p>03 Strategic Quality Programs:</p> <ul style="list-style-type: none"> • Strategic Quality Programs, EFQM, RADAR, Six Sigma, Sigma Levels, ACQMM (Aachener QM Modell) , Quality Stream (Basic statistics in the exercise) <p>04 Quality and Economics:</p> <ul style="list-style-type: none"> • Quality controlling, quality cost accounting, cost-related process performance, cost-related quality performance indicators, balanced scorecard, target costing <p>05 QM in Field Data Evaluation:</p> <ul style="list-style-type: none"> • Field Data analysis, Weibull-Analysis, Isochron-Diagram, MIS-Diagram <p>06 QM in Manufacturing:</p> <ul style="list-style-type: none"> • Statistical Process Control, 5S, Value Stream Mapping <p>07 QM in the Early Phases - Focus Product:</p> <ul style="list-style-type: none"> • Kano-Model, Quality Function Deployment (QFD), House of Quality, TRIZ <p>08 QM in the Early Phases - Focus Process:</p> <ul style="list-style-type: none"> • Process Optimization , Design of Experiments (DoE), Factorial Designs, Shainin Methodology <p>09 QM in the Early Phases - Deviation:</p> <ul style="list-style-type: none"> • Design Review, Quality Assessment, Fault Tree Analysis, FMEA, DRBFM, Rapid Quality Deployment <p>10 QM in the Procurement:</p> <ul style="list-style-type: none"> • Procurement Strategies, supplier selection, incoming inspection, accepted quality level <p>11 Quality and Information:</p> <ul style="list-style-type: none"> • Quality control loops, quality data basis, Computer Aided Quality Management (CAQ), computer-aided test planning, implementation of CAQ systems

	12 QM in Service Industries: • Service Engineering, Service Level Agreement, Service Blueprinting, ServQual, Vignette Techniques, Service FMEA, Conjoint Analyses					
Media Medienform	e-Learning L ² P, Power Point					
Literature Literatur						
Lectures / Examinations Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kredit- punkte	Workload Arbeits- aufwand (h)	Lecture H. Kontakt- zeit (h)	Self-study Selbst- studium (h)	Duration of Exam Prüfungs- dauer (min)
Examination (Prüfung): Quality Management	MSPSE	6	0	0	0	240
Lecture (Vorlesung): Quality Management	MSPSE	0	90	30	60	
Exercise (Übung): Quality Management	MSPSE	0	90	30	60	
Teaching Unit / Examinations: Examination Quality Management Studien-/Prüfungsleistung: Prüfung Quality Management						
Title Titel	Examination Quality Management Prüfung Quality Management					
Sub-title Untertitel	QM					
Semester Studiensemester	2					
Connection to the curriculum Curriculare Verankerung	Compulsory module (variable to the semester) Semestervariable Pflichtleistung					
Teaching Unit / Examinations: Lecture Quality Management Studien-/Prüfungsleistung: Vorlesung Quality Management						
Title Titel	Lecture Quality Management Vorlesung Quality Management					
Sub-title Untertitel	V QM					
Semester Studiensemester	2					
Connection to the curriculum Curriculare Verankerung	Compulsory module (variable to the semester) Semestervariable Pflichtleistung					
Teaching Unit / Examinations: Exercise Quality Management Studien-/Prüfungsleistung: Übung Quality Management						
Title Titel	Exercise Quality Management Übung Quality Management					
Sub-title Untertitel	Ü QM					
Semester Studiensemester	2					
Connection to the curriculum Curriculare Verankerung	Compulsory module (variable to the semester) Semestervariable Pflichtleistung					

Module (Modul): German Language Course

Module Modulbezeichnung	German Language Course
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	GLC
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	1
Person in Charge Modulverantwortliche	Variable
Lecturer Dozenten	Variable
Language Sprache	deutsch
Assignment to the curriculum Zuordnung zum Curriculum	Sprachenzentrum/Sprachenzentrum/Deutsch als Fremdsprache/Semesterkurse/ Stufe A1 GER
Teaching form Lehrformen	Written examination, Lecture/Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload Arbeitsaufwand	Total 180h, Contact hours 60h, Self-study 120h Gesamt 180 h, Kontaktzeit 60 h, Selbststudium 120 h
Lecture hours Kontaktzeit (SWS)	4
ECTS-Credit Points (CP) Kreditpunkte	6
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	-none-
Learning Objectives Angestrebte Lernergebnisse	<p>German Language</p> <p>After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding:</u></p> <p><i>Students</i></p> <ol style="list-style-type: none"> Communicate basic knowledge on German Culture and Cultural Studies; German classes enable one to accomplish everyday communication within university surroundings (dormitory, cafeteria etc.); German classes offer prerequisites for culturally adequate application documents for internships (CV, letter of motivation); <p><u>Abilities /Skills:</u></p> <p><i>Students</i></p> <ol style="list-style-type: none"> Communicate insight into cultural situations at German universities
Content Inhalt	<p>German Language</p> <ul style="list-style-type: none"> Getting to know someone Introducing oneself City explorations

	<ul style="list-style-type: none"> • Orientation in the city • Techniques: learning and remembering words • Buying groceries • Communication on the phone • Techniques: learning grammar systematically • Calendar, festivities • Holidays • Learning and forgetting • Learning psychology • German newspapers • Reading habits • When in Rome, do as the Romans do • Intercultural experience • Media • Geographic German studies • Inventions and progress • Between cultures • Environmental protection/problems • Project Europe • Job market Germany • Applications • CVs 					
Media Medienform	e-Learning L ² P, Power Point					
Literature Literatur						
Lectures / Examinations Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kredit- punkte	Workload Arbeits- aufwand (h)	Lecture H. Kontakt- zeit (h)	Self-study Selbst- studium (h)	Duration of Exam Prüfungs- dauer (min)
Examination (Prüfung): German Language Course	MSPSE	6	0	0	0	120
Lecture/Exercise (Vorlesung/Übung): German Language Course	MSPSE	0	180	60	120	
Teaching Unit / Examinations: Examination German Language Course Studien-/Prüfungsleistung: Prüfung German Language Course						
Title Titel	Lecture/Exercise German Language Course Prüfung German Language Course					
Sub-title Untertitel	GLC					
Semester Studiensemester	1					
Connection to the curriculum Curriculare Verankerung	Compulsory module (variable to the semester) Semestervariable Pflichtleistung					
Teaching Unit / Examinations: Lecture/Exercise German Language Course Studien-/Prüfungsleistung: Vorlesung/Übung German Language Course						
Title Titel	Lecture/Exercise German Language Course Vorlesung/Übung German Language Course					
Sub-title Untertitel	VÜ GLC					
Semester Studiensemester	1					
Connection to the curriculum	Compulsory module (variable to the semester) Semestervariable Pflichtleistung					

Curriculare Verankerung	
-------------------------	--

Module (Modul): Master Thesis

Module Modulbezeichnung	Master Thesis				
Modul level Modulniveau					
Code Kürzel	MSPSE				
Subtitle Untertitel	Master Thesis				
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls				
Semester Studiensemester	3				
Person in Charge Modulverantwortliche	Variable				
Lecturer Dozenten	Variable				
Language Sprache	English Englisch				
Assignment to the curriculum Zuordnung zum Curriculum	Compulsory Module Pflichtmodul				
Teaching form Lehrformen					
Workload Arbeitsaufwand	Total 6 months Gesamt 6 Monate				
Lecture hours Kontaktzeit (SWS)	0				
ECTS-Credit Points (CP) Kreditpunkte	30				
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	Mandatory: • 45 ECTS				
Learning Objectives Angestrebte Lernergebnisse	Master Thesis The students learn the independent approach and processing of academic themes, their documentation and written interpretation within a set deadline. They acquire systematic academic research skills.				
Content Inhalt	Master Thesis Completed academic paper which shall show that the students are capable of independently processing a problem related to their subject according to academic methods within a set deadline. Wissenschaftliche abgeschlossene Arbeit, die zeigen soll, dass die Studierenden in der Lage sind, ein Problem aus einem in Beziehung zu ihrem stehenden Fach in begrenzter Frist selbstständig nach wissenschaftlichen Methoden zu bearbeiten.				
Media Medienform					
Literature Literatur					
Teaching Unit / Examinations: Master Thesis and Master Thesis Kolloquium Studien-/Prüfungsleistung: Master Thesis and Master Thesis Kolloquium					
Title Titel	ECTS	Workload	Lecture H.	Self-study	Duration of Exam

	Kreditpunkte	Arbeitsaufwand (h)	Kontaktzeit (h)	Selbststudium (h)	Prüfungsdauer (min)
Master Thesis (Masterarbeit) Title	28	0	0	0	0
Master´s Thesis defense colloquium (Masterarbeitskolloquium)	2	0	0	0	30-60
Teaching Unit / Examinations: Master Thesis and Master Thesis Kolloquium Studien-/Prüfungsleistung: Master Thesis and Master Thesis Kolloquium					
Title Titel	Master Thesis and Master Thesis Kolloquium				
Sub-title Untertitel	MastThesis				
Semester Studiensemester	3				
Connection to the curriculum Curriculare Verankerung	Compulsory module (variable to the semester) Semestervariable Pflichtleistung				

Module (Modul): Gear and Transmission Technology

Module Modulbezeichnung	Gear and Transmission Technology
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	GTT
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	2
Person in Charge Modulverantwortliche	Brecher, Christian Klocke, Fritz
Lecturer Dozenten	Brecher, Christian Klocke, Fritz
Language Sprache	English Englisch
Assignment to the curriculum Zuordnung zum Curriculum	Compulsory Module Pflichtmodul
Teaching form Lehrformen	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload Arbeitsaufwand	Total 180h, Contact hours 60h, Self-study 120h Gesamt 180 h, Kontaktzeit 60 h, Selbststudium 120 h
Lecture hours Kontaktzeit (SWS)	4
ECTS-Credit Points (CP) Kreditpunkte	6
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	-none-
Learning Objectives Angestrebte Lernergebnisse	<p>Gear and Transmission Technology</p> <p>After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding:</u></p> <p><i>Students</i></p> <ul style="list-style-type: none"> a) learn about the requirements on modern gears b) know the basics of calculation and test methods that are used in the development process of gears c) understand how test rigs for fatigue and gear noise tests will be introduced. d) get knowledge about the gear production and the machine tools for gear production. <p><u>Abilities / Skills:</u></p> <p><i>Students</i></p> <ul style="list-style-type: none"> a) gain experience in simulation techniques in gear design and corresponding manufacturing processes. b) gain experience in the analysis of gear tests.

Content Inhalt	Gear and Transmission Technology					
	Introduction <ul style="list-style-type: none"> • Gear Geometry - Spur Gears • Damage of gears • Basics of the gear development process I • Basics of the gear development process II • Investigation of gears - Fatigue tests • Investigation of gears - Running behavior • Gear Production • Gear Production – Finishing • Machine Tools for Gear Production • Simulation • Gear Geometry - Bevel Gears • Special Gears, Beveloids 					
Media Medienform	e-Learning L ² P, Power Point					
Literature Literatur	Lecture script					
Lectures / Examinations Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kreditpunkte	Workload Arbeitsaufwand (h)	Lecture H. Kontaktzeit (h)	Self-study Selbststudium (h)	Duration of Exam Prüfungsdauer (min)
Examination (Prüfung): Gear and Transmission Technology	MSPSE	6	0	0	0	120
Lecture/Exercise (Vorlesung/Übung): Gear and Transmission Technology	MSPSE	0	90	30	60	
Exercise (Übung): Gear and Transmission Technology	MSPSE	0	90	30	60	
Teaching Unit / Examinations: Examination Gear and Transmission Technology Studien-/Prüfungsleistung: Prüfung Gear and Transmission Technology						
Title Titel	Examination Gear and Transmission Technology Prüfung Gear and Transmission Technology					
Sub-title Untertitel						
Semester Studiensemester	2					
Connection to the curriculum Curriculare Verankerung	Compulsory module Semestervariable Wahlleistung					
Teaching Unit / Examinations: Lecture Gear and Transmission Technology Studien-/Prüfungsleistung: Vorlesung Gear and Transmission Technology						
Title Titel	Lecture Gear and Transmission Technology Vorlesung Gear and Transmission Technology					
Sub-title Untertitel						
Semester Studiensemester	2					

Connection to the curriculum Curriculare Verankerung	Compulsory module Semestervariable Wahlleistung
Teaching Unit / Examinations: Exercise Gear and Transmission Technology Studien-/Prüfungsleistung: Übung Gear and Transmission Technology	
Title Titel	Lecture Gear and Transmission Technology Vorlesung Gear and Transmission Technology
Sub-title Untertitel	
Semester Studiensemester	2
Connection to the curriculum Curriculare Verankerung	Compulsory module Semestervariable Wahlleistung

Module (Modul): Mechatronics and Control Techniques for Production Plants

Module Modulbezeichnung	Mechatronics and Control Techniques for Production Plants
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	MCP
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	2
Person in Charge Modulverantwortliche	Brecher, Christian
Lecturer Dozenten	Brecher, Christian
Language Sprache	English Englisch
Assignment to the curriculum Zuordnung zum Curriculum	Compulsory Module Pflichtmodul
Teaching form Lehrformen	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload Arbeitsaufwand	Total 180h, Contact hours 60h, Self-study 120h Gesamt 180 h, Kontaktzeit 60 h, Selbststudium 120 h
Lecture hours / Contact hours Kontaktzeit (SWS)	4
ECTS-Credit Points (CP) Kreditpunkte	6
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	-none-
Learning Objectives Angestrebte Lernergebnisse	<p>Mechatronics and Control Techniques for Production Plants</p> <p>Students get familiar with the structure, the design and the engineering process of mechatronic systems. After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding:</u></p> <ul style="list-style-type: none"> a) understand the characteristics of the behavior and control of feed axes in machine tools; b) know different types of sensors and their application within machine tools <p><u>Abilities / Skills:</u></p> <ul style="list-style-type: none"> a) apply this knowledge to create control programs in different programming tools b) get to know the essential features and applications of logical, numerical and motion controls of machines
Content	

Inhalt	Mechatronics and Control Techniques for Production Plants					
	<p><i>Introduction to Mechatronics and control for production</i></p> <ul style="list-style-type: none"> - Overview of mechatronic systems - Construction of feed drives <p><i>Information processing in mechatronic systems</i></p> <ul style="list-style-type: none"> - Theory and examples of embedded systems - Programmable logic circuits <p><i>Measurement systems and sensors</i></p> <ul style="list-style-type: none"> - Position and angle measuring systems - Acceleration and vibration measurement <p><i>Mechanical control</i></p> <ul style="list-style-type: none"> - Single and multi-spindle turning machines - Further developments <p><i>Gripping technology</i></p> <ul style="list-style-type: none"> - Gripping principles - Sensor technology and applications <p><i>Position control of feed drives</i></p> <ul style="list-style-type: none"> - Control concept of a machine axis - Accuracy and synchronous control of multi-axis <p><i>Numerical Control 1: structure, programming, CAM</i></p> <ul style="list-style-type: none"> - Construction of NC controls - NC programming process <p><i>Numerical Control 2: Interpolation</i></p> <ul style="list-style-type: none"> - Kinematic transformations and compensations - Interpolation <p><i>Industrial robots and handling systems, robot control</i></p> <ul style="list-style-type: none"> - Structure and kinematic transformations - RC programming <p><i>Programmable Logic Control (PLC) and motion control (MC)</i></p> <ul style="list-style-type: none"> - Basics of Information Processing - Programmable Controllers <p><i>Signal processing, process and condition monitoring</i></p> <ul style="list-style-type: none"> - Tasks of process and condition monitoring - Use of sensors and signal processing <p><i>Mechatronic Engineering, Simulation environments for virtual commissioning</i></p> <ul style="list-style-type: none"> - Basics of modeling of mechatronic systems - Behavior modeling and data management - Introduction: complexity of software and systems 					
Media Medienform	e-Learning L ² P, Power Point					
Literature Literatur	Lecture Notes Students also receive a list of relevant literature					
Lectures / Examinations Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kredit- punkte	Workload Arbeits- aufwand (h)	Lecture H. Kontakt- zeit (h)	Self-Study Selbst- studium (h)	Duration of Exam Prüfungs- dauer (min)
Examination (Prüfung): Mechatronics and Control	MSPSE	6	0	0	0	120

Techniques for Production Plants						
Lecture (Vorlesung): Mechatronics and Control Techniques for Production Plants	MSPSE	0	90	30	60	0
Exercise (Übung): Mechatronics and Control Techniques for Production Plants	MSPSE	0	90	30	60	0
Teaching Unit / Examinations: Mechatronics and Control Techniques for Production Plants Studien-/Prüfungsleistung: Prüfung Mechatronics and Control Techniques for Production Plants						
Title Titel	Examination Mechatronics and Control Techniques for Production Plants Prüfung Mechatronics and Control Techniques for Production Plants					
Sub-title Untertitel	Examination MCP Prüfung MCP					
Semester Studiensemester	2					
Connection to the curriculum Curriculare Verankerung	Compulsory module (variable to the semester) Semestervariable Pflichtleistung					
Teaching Unit / Examinations: Examination Mechatronics and Control Techniques for Production Plants Studien-/Prüfungsleistung: Prüfung Mechatronics and Control Techniques for Production Plants						
Title Titel	Lecture Mechatronics and Control Techniques for Production Plants Vorlesung Mechatronics and Control Techniques for Production Plants					
Sub-title Untertitel	Lecture MCP Vorlesung MCP					
Semester Studiensemester	2					
Connection to the curriculum Curriculare Verankerung	Compulsory module (variable to the semester) Semestervariable Pflichtleistung					
Teaching Unit / Examinations: Examination Mechatronics and Control Techniques for Production Plants Studien-/Prüfungsleistung: Prüfung Mechatronics and Control Techniques for Production Plants						
Title Titel	Exercise Mechatronics and Control Techniques for Production Plants Übung Mechatronics and Control Techniques for Production Plants					
Sub-title Untertitel	Exercise MCP Übung MCP					
Semester Studiensemester	2					
Connection to the curriculum Curriculare Verankerung	Compulsory module (variable to the semester) Semestervariable Pflichtleistung					

Elective Courses

Module (Modul): Control Engineering

Module Modulbezeichnung	Control Engineering
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	CE
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	2
Person in Charge Modulverantwortliche	Abel, Dirk
Lecturer Dozenten	Abel, Dirk
Language Sprache	English Englisch
Assignment to the curriculum Zuordnung zum Curriculum	Elective module Semestervariable Wahlpflichtleistung
Teaching form Lehrformen	Oral Examination, Exercise, Lecture Mündliche Prüfung (MP), Übung (Ü), Vorlesung (V)
Workload Arbeitsaufwand	Total 90h, Contact hours 30h, Self-study 60h Gesamt 90 h, Kontaktzeit 30 h, Selbststudium 60 h
Lecture hours Kontaktzeit (SWS)	2
ECTS-Credit Points (CP) Kreditpunkte	3
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	Basic knowledge in mathematics as defined in the examination regulations.
Learning Objectives Angestrebte Lernergebnisse	<p>Control Engineering</p> <p>After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding:</u></p> <ol style="list-style-type: none"> know, recognize and classify the most common linear control loop elements the effects of feedback and apply different methods to set up feedback elements (controllers) such that predefined control goals are met <p><u>Abilities / Skills:</u></p> <ol style="list-style-type: none"> to analyze dynamical, biological and biomedical systems and identify the relevant causalities to employ different mathematical descriptions of dynamical systems solve differential equations by means of Laplace transform assess of the stability of dynamical systems using different methods obtain, interpret and employ the frequency response of dynamical systems

Content Inhalt	Control Engineering Significance of control theory, examples of biological and biomedical control loops, functional diagrams, linearization, set up and solving of differential equations, stability, features in time domain of dynamical systems, Laplace transform, transfer function, frequency response, functional diagram algebra, features in frequency domain of dynamical systems, bode diagram, Nyquist plot, Linear control loop elements, principle and goals of controller design, algebraic stability criteria, steady state analysis and transient performance of a control loop, controller setting rules, Nyquist stability criterion, phase margin, gain margin, controller design in bode diagram.					
Media Medienform	e-Learning L ² P, Power Point					
Literature Literatur						
Lectures / Examinations Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kredit- punkte	Workload Arbeits- aufwand (h)	Lecture H. Kontakt- zeit (h)	Self-study Selbst- studium (h)	Duration of Exam Prüfungs- dauer (min)
Examination (Prüfung): Control Engineering	MSPSE	3	0	0	0	120
Lecture (Vorlesung): Control Engineering	MSPSE	0	45	15	30	
Exercise (Übung): Control Engineering	MSPSE	0	45	15	30	
Teaching Unit / Examinations: Examination Control Engineering Studien-/Prüfungsleistung: Prüfung Control Engineering						
Title Titel	Examination Control Engineering Prüfung Control Engineering					
Sub-title Untertitel	CE					
Semester Studiensemester	2					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlleistung					
Teaching Unit / Examinations: Lecture Control Engineering Studien-/Prüfungsleistung: Vorlesung Control Engineering						
Title Titel	Lecture Control Engineering Vorlesung Control Engineering					
Sub-title Untertitel	V CE					
Semester Studiensemester	2					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlleistung					
Teaching Unit / Examinations: Exercise Control Engineering Studien-/Prüfungsleistung: Übung Control Engineering						
Title Titel	Exercise Control Engineering Übung Control Engineering					
Sub-title Untertitel	Ü CE					
Semester	2					

Studiensemester	
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlleistung

Module (Modul): Industrial Logistics

Module Modulbezeichnung	Industrial Logistics
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	IL
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	1
Person in Charge Modulverantwortliche	Schuh, Günther Stich, Volker
Lecturer Dozenten	Schuh, Günther; Stich, Volker
Language Sprache	English Englisch
Assignment to the curriculum Zuordnung zum Curriculum	Elective module Semestervariable Wahlpflichtleistung
Teaching form Lehrformen	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload Arbeitsaufwand	Total 150h, Contact hours 45, Self-study 105h Gesamt 150 h, Kontaktzeit 45 h, Selbststudium 105 h
Lecture hours Kontaktzeit (SWS)	3
ECTS-Credit Points (CP) Kreditpunkte	5
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	-none-
Learning Objectives Angestrebte Lernergebnisse	<p>Industrial Logistics</p> <p>After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding:</u> <i>Students</i></p> <p>a) know objectives and tasks of industrial logistics as well as main aspects of industrial logistics from organisational involvement to logistics controlling.</p> <p><u>Abilities / Skills:</u> <i>Students</i></p> <p>a) understand the meaning and the effects of individual aspects of industrial logistics and can place them in the overall context</p> <p><u>Competences:</u> <i>Students</i></p> <p>a) are able to apply the acquired knowledge in Industrial Logistics to practical problems</p>
Content	Industrial Logistics

Inhalt	<ul style="list-style-type: none"> • The lecture course "Industrial Logistics" covers a wide range of topics, which are relevant for the field of logistics. • It starts by appointing the logistics objectives and tasks. The following lectures cover the topics procurement, inventory management, product distribution and other related themes. Finally the lecture on Supply Chain Management is presented, whereby the new developments in the field of logistics research are of particular interest. • In addition, two guest lectures by external lecturers and an excursion complement the educational programme. <p><u>Content</u></p> <ul style="list-style-type: none"> • Introduction - Objectives and Tasks of Logistics • Procurement • Distribution • Inventory Management • Process- and Information Management • Material Flow Planning • Smart Objects • Supply Chain Management 					
Media Medienform	e-Learning L ² P, Power Point					
Literature Literatur						
Lectures / Examinations Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kreditpunkte	Workload Arbeitsaufwand (h)	Lecture H. Kontaktzeit (h)	Self-study Selbststudium (h)	Duration of Exam Prüfungsdauer (min)
Examination (Prüfung): Industrial Logistics	MSPSE	5	0	0	0	120
Lecture (Vorlesung): Industrial Logistics	MSPSE	0	90	30	60	
Exercise (Übung): Industrial Logistics	MSPSE	0	60	15	45	
Teaching Unit / Examinations: Examination Industrial Logistics Studien-/Prüfungsleistung: Prüfung Industrial Logistics						
Title Titel	Examination Industrial Logistics Prüfung Industrial Logistics					
Sub-title Untertitel	IL					
Semester Studiensemester	1					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlleistung					
Teaching Unit / Examinations: Lecture Industrial Logistics Studien-/Prüfungsleistung: Vorlesung Industrial Logistics						
Title Titel	Lecture Industrial Logistics Vorlesung Industrial Logistics					
Sub-title Untertitel	V IL					
Semester Studiensemester	1					
Connection to the curriculum	Elective module Semestervariable Wahlleistung					

Curriculare Verankerung	
Teaching Unit / Examinations: Exercise Industrial Logistics Studien-/Prüfungsleistung: Übung Industrial Logistics	
Title Titel	Examination Industrial Logistics Übung Industrial Logistics
Sub-title Untertitel	Ü IL
Semester Studiensemester	1
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlleistung

Module (Modul): Multibody Dynamics

Module Modulbezeichnung	Multibody Dynamics
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	MD
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	1
Person in Charge Modulverantwortliche	Corves, Burkhard
Lecturer Dozenten	Corves, Burkhard
Language Sprache	English Englisch
Assignment to the curriculum Zuordnung zum Curriculum	Elective module Semestervariable Wahlpflichtleistung
Teaching form Lehrformen	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload Arbeitsaufwand	Total 180h, Contact hours 60 h, Self-study 120 Gesamt 180 h, Kontaktzeit 60 h, Selbststudium 120 h
Lecture hours Kontaktzeit (SWS)	4
ECTS-Credit Points (CP) Kreditpunkte	6
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	-none-
Learning Objectives Angestrebte Lernergebnisse	<p>Multibody Dynamics</p> <p>After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding:</u></p> <ol style="list-style-type: none"> The students have a profound knowledge of theory of vibrations. The students are capable of comprehending, describing and analyzing vibratory systems. The students are familiar with the most important matrix based procedures for the calculation of eigen motions and the behavior of linear systems under forced excitations. For the calculation of nonlinear system the students can select suitable program systems and carry out proper simulations. <p><u>Abilities / Skills:</u></p> <ol style="list-style-type: none"> The students have the ability of describing mathematically any mechanical system with its inherent physical effects like elasticity, damping and friction.

	<p>b) The students are able to properly interpret simulation results especially under consideration of simplifications within the model compared to the real system.</p> <p><u>Competencies:</u></p> <p>a) The students are able to derive from their knowledge the necessary methods and proceedings for the analysis and synthesis of the systems in regard. Thus they are capable to solve - accessing their acquired theoretical knowledge - complex problems concerning the choice and design of industrial vibratory systems.</p>
<p>Content Inhalt</p>	<p>Multibody Dynamics</p> <ul style="list-style-type: none"> • Introduction • Fundamentals • Fields of application • Model Building <ul style="list-style-type: none"> • Methods of Approach for Equivalent Models • Multi-body Systems • Determination of the Model Parameters • General mathematical description • Kinematics of Multi Body Systems <ul style="list-style-type: none"> • Position and Orientation of Bodies • Translational Kinematics • Rotational Kinematics • Equations of Motion <ul style="list-style-type: none"> • Lagrangian Equations of 2nd Kind • Newton-Euler equations • Linearisation • Eigen Value Approach • Undamped non-gyroscopic systems • Damped gyroscopic systems • Eigen Value Stability Criteria <p>Linear Systems with Harmonic Excitation</p> <ul style="list-style-type: none"> • Real Frequency Matrix • Complex Frequency Matrix • State Equation • System Matrix • Eigen Value Approach • Fundamental Matrix • Modal Matrix • Theorem of Cayley-Hamilton • Analytical Solution • Numerical Solution • Step Excitation • Harmonic Excitation • Periodical Excitation <p>Introduction of Multi Body Simulation Software</p> <ul style="list-style-type: none"> • ADAMS • SIMPACK • SimMechanics

	Hands-On-Laboratory for Multi Body Simulation Software					
	<ul style="list-style-type: none"> • ADAMS • SIMPACK • SimMechanics 					
	<p>Example</p> <ul style="list-style-type: none"> • Modelling • Determination of Parameters • Calculation • Evaluation 					
Media Medienform	e-Learning L ² P, Power Point					
Literature Literatur						
Lectures / Examinations						
Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kredit- punkte	Workload Arbeits- aufwand (h)	Lecture H. Kontakt- zeit (h)	Self-study Selbst- studium (h)	Duration of Exam Prüfungs- dauer (min)
Examination (Prüfung): Multibody Dynamics	MSPSE	6	0	0	0	120
Lecture (Vorlesung): Multibody Dynamics	MSPSE	0	90	30	60	
Exercise (Übung): Multibody Dynamics	MSPSE	0	90	30	60	
Teaching / Examinations: Examination Multibody Dynamics						
Studien-/Prüfungsleistung: Prüfung Multibody Dynamics						
Title Titel	Examination Multibody Dynamics Prüfung Multibody Dynamics					
Sub-title Untertitel	MD					
Semester Studiensemester	1					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlleistung					
Teaching / Examinations: Lecture Multibody Dynamics						
Studien-/Prüfungsleistung: Vorlesung Multibody Dynamics						
Title Titel	Lecture Multibody Dynamics Vorlesung Multibody Dynamics					
Sub-title Untertitel	V MD					
Semester Studiensemester	1					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlleistung					
Teaching / Examinations: Exercise Multibody Dynamics						
Studien-/Prüfungsleistung: Übung Multibody Dynamics						
Title Titel	Exercise Multibody Dynamics Übung Multibody Dynamics					
Sub-title Untertitel	Ü MD					
Semester	1					

Studiensemester	
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlleistung

Module (Modul): Process Chains for Replication of complex optical Elements

Module Modulbezeichnung	Process Chains for Replication of complex optical Elements
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	PCCOC
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	1
Person in Charge Modulverantwortliche	Klocke, Fritz
Lecturer Dozenten	Klocke, Fritz
Language Sprache	English Englisch
Assignment to the curriculum Zuordnung zum Curriculum	Elective module Semestervariable Wahlpflichtleistung
Teaching form Lehrformen	Oral examination, Lecture, Exercise Mündliche Prüfung (MP), Vorlesung (V)
Workload Arbeitsaufwand	Total 90h, Contact hours 30h, Self-study 60h Gesamt 90 h, Kontaktzeit 30 h, Selbststudium 60 h
Lecture hours Kontaktzeit (SWS)	2
ECTS-Credit Points (CP) Kreditpunkte	3
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	-none-
Learning Objectives Angestrebte Lernergebnisse	<p>Process Chains for Replication of complex optical Elements</p> <p>After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding:</u> <i>Students</i></p> <ul style="list-style-type: none"> c) Know and understand direct machining and replication methods for complex optical lens production. d) Know and understand the characteristics of ultra-precision machine tools for machining optical components. e) Understand the measurement methods that are established in ultra-precision shape, surface and rim zone characterization. <p><u>Abilities / Skills:</u> <i>Students</i></p> <ul style="list-style-type: none"> c) Apply this knowledge and are able to assess manufacturing processes, machine tools and metrology methods with regard to the demands of optical components. d) Are able to evaluate production strategies for higher quality, higher output, higher complexity and lower costs. <p><u>Competences:</u></p>

	<p><i>Students</i></p> <p>c) Critically analyze company decisions with a technological background and communicate the assessments to non-specialist audiences.</p> <p>Are familiar with the latest production trends in the seminal optics branch.</p>					
Content Inhalt	<p>Process Chains for Replication of complex optical Elements</p> <p>The lecture covers replication methods for complex optical elements in consumables and shows production strategies for higher quality, higher output, higher complexity and lower costs. The entire process chain will be considered, from design procedures, to mold making, coatings and replication technologies. For each step, the relevant metrology methods are explained. The replication processes cover injection molding of plastic optics and hot pressing of glass optics. The lecture is an e-learning offer, which consists of 10 lectures that can be downloaded (videos, slides). The exam can be done at RWTH Aachen, Bremen University or Stillwater (USA).</p> <p>Setup:</p> <p>L1: Introduction (Prof. Brinksmeier) L2: Machine Technology for Ultra Precision Optics Manufacturing (Prof. Brecher) L3: Mold machining processes for plastic optics (Prof. Brinksmeier) L4: Direct manufacturing and mold making for glass optics (Prof. Klocke) L5: Coatings for optical molds (Prof. Zoch, Dr. Mehner) L6: Modification and characterization of hard coatings (Prof. Lucca) L7: Replication of plastic optics (Prof. Michaeli) L8: Molding of glass optics (Prof. Klocke) L9: Measurement technology (Prof. Goch) L10: Organization and quality management of process chains (Prof. Schmitt)</p>					
Media Medienform	e-Learning L ² P, Power Point					
Literature Literatur						
Lectures / Examinations Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kreditpunkte	Workload Arbeitsaufwand (h)	Lecture H. Kontaktzeit (h)	Self-study Selbststudium (h)	Duration of Exam Prüfungsdauer (min)
Examination (Prüfung): Process Chains for Replication of Complex Optical Elements	MSPSE	3	0	0		Written: 90 min. Oral: 15 min. per student
Lecture (Vorlesung): Process Chains for Replication of Complex Optical Elements	MSPSE	0	90	30	60	
Teaching / Examinations: Examination Process Chains for Replication of Complex Optical Elements Studien-/Prüfungsleistung: Process Chains for Replication of Complex Optical Elements						
Title Titel	Examination Process Chains for Replication of Complex Optical Component Prüfung Process Chains for Replication of Complex Optical Component					
Subtitle Untertitel	E PCCOC					
Semester Studiensemester	1					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlleistung					
Teaching / Examinations: Lecture Process Chains for Replication of Complex Optical Elements Studien-/Prüfungsleistung: Vorlesung Process Chains for Replication of Complex Optical Elements						
Title Titel	Lecture Process Chains for Replication of Complex Optical Elements Vorlesung Process Chains for Replication of Complex Optical Elements					

Sub-title Untertitel	V PCCOC
Semester Studiensemester	1
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlleistung
Teaching / Examinations: Exercise Lecture Process Chains for Replication of Complex Optical Elements Studien-/Prüfungsleistung: Übung Lecture Process Chains for Replication of Complex Optical Elements	
Title Titel	Exercise Lecture Process Chains for Replication of Complex Optical Elements Übung Lecture Process Chains for Replication of Complex Optical Elements
Sub-title Untertitel	Ü PCCOC
Semester Studiensemester	1
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlleistung

Module (Modul): Production Metrology

Module Modulbezeichnung	Production Metrology
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	ProMet
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	1
Person in Charge Modulverantwortliche	Schmitt, Robert
Lecturer Dozenten	Schmitt, Robert
Language Sprache	English Englisch
Assignment to the curriculum Zuordnung zum Curriculum	Elective module Semestervariable Wahlpflichtleistung
Teaching form Lehrformen	
Workload Arbeitsaufwand	Total 150, Contact hours 60h, Self-study 90h Gesamt 150 h, Kontaktzeit 60 h, Selbststudium 90 h
Lecture hours Kontaktzeit (SWS)	4
ECTS-Credit Points (CP) Kreditpunkte	5
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	None
Learning Objectives Angestrebte Lernergebnisse	<p>Production Metrology</p> <p>The aim of this lecture is to create the awareness, that "measuring" comprehends a lot more than plain data acquisition and metrology is a vital part of modern production processes.</p> <p>After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding:</u> <i>Students</i></p> <ul style="list-style-type: none"> a) know the function and the responsibility of metrology for production b) know the theoretical fundamentals which have to be taken into consideration while the measuring process is planned, controlled, analysed, are discussed c) know current measuring principles and devices in the field of industrial production d) know statistical fundamentals being necessary for analysis of the measured values

	<p><u>Abilities / Skills:</u> <i>Students</i></p> <ul style="list-style-type: none"> a) are able, to define measuring task on the basis of given features b) are able, to select adequate measuring devices for measuring tasks c) are able, to interpret measuring results <p><u>Competencies:</u> <i>Students</i></p> <ul style="list-style-type: none"> a) can make their decision (having arguments) for using metrology within production b) have learned to make decisions concerning measurement on the base of different parameters
<p>Content Inhalt</p>	<p>Production Metrology</p> <p><u>Introduction</u></p> <ul style="list-style-type: none"> • Relevance of metrology for quality assurance and its integration in production processes. <p><u>Metrological Basics</u></p> <ul style="list-style-type: none"> • Metrological concepts and definitions (Calibration, Uncertainty etc.) <p><u>Tolerancing</u></p> <ul style="list-style-type: none"> • Form and positional tolerances, tolerancing principles and basics <p><u>Inspection Planning</u></p> <ul style="list-style-type: none"> • Tasks and workflow of inspection planning, Procedure for creation of inspection plans <p><u>Shop floor measuring devices/ Measuring sensors</u></p> <ul style="list-style-type: none"> • Commonly used manual inspection devices for the shop floor, Function and application of inductive, capacitive and pneumatical sensors <p><u>Optoelectronic inspection devices</u></p> <ul style="list-style-type: none"> • Optical inspection systems for geometry testing and applications <p><u>Form and surface inspection devices</u></p> <ul style="list-style-type: none"> • Tactile and optical system for the characterisation of forms and surfaces, surfaces parameters <p><u>Coordinate measurement technology</u></p> <ul style="list-style-type: none"> • Principles, types and applications of coordinate measuring machines <p><u>Gauging inspection</u></p> <ul style="list-style-type: none"> • Form and positional gauging, Gauging Procedures <p><u>Statistical basics</u></p> <ul style="list-style-type: none"> • Statistical parameters for the description of production and • measuring processes, tests on normal distribution <p><u>SPC, Process Capability</u></p> <ul style="list-style-type: none"> • Statistical analysis and control of processes, Process capability indices <p><u>Inspection device management</u></p> <ul style="list-style-type: none"> • Tasks and procedures of inspection device management, Calculation of measuring device capability, Calibration chain
<p>Media Medienform</p>	<p>e-Learning L²P, Power Point</p>
<p>Literature Literatur</p>	

Lectures / Examinations Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kredit- punkte	Workload Arbeits- aufwand (h)	Lecture H. Kontakt- zeit (h)	Self-study Selbst- studium (h)	Duration of Exam Prüfungs- dauer (min)
Examination (Prüfung): Production Metrology	MSPSE	5	0	0	0	120
Lecture (Vorlesung): Production Metrology	MSPSE	0	75	30	45	
Exercise (Übung): Production Metrology	MSPSE	0	75	30	45	
Teaching Unit / Examinations: Examination Production Metrology Studien-/Prüfungsleistung: Prüfung Production Metrology						
Title Titel	Examination Production Metrology Prüfung Production Metrology					
Sub-title Untertitel	ProMet					
Semester Studiensemester	1					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					
Teaching Unit / Examinations: Lecture Production Metrology Studien-/Prüfungsleistung: Vorlesung Production Metrology						
Title Titel	Lecture Production Metrology Vorlesung Production Metrology					
Sub-title Untertitel	V ProMet					
Semester Studiensemester	1					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					
Teaching Unit / Examinations: Exercise Production Metrology Studien-/Prüfungsleistung: Übung Production Metrology						
Title Titel	Exercise Production Metrology Übung Production Metrology					
Sub-title Untertitel	Ü ProMet					
Semester Studiensemester	1					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					

Module (Modul): Factory Planning

Module Modulbezeichnung	Factory Planning
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	FP
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	1
Person in Charge Modulverantwortliche	Achim Kampker
Lecturer Dozenten	Achim Kampker
Language Sprache	English Englisch
Assignment to the curriculum Zuordnung zum Curriculum	Elective module Semestervariable Wahlpflichtleistung
Teaching form Lehrformen	Written Examination, Lecture, Exercise Klausur (Kl), Vorlesung (V)
Workload Arbeitsaufwand	Total 180, Contact hours 60h, Self-study 120h Gesamt 180 h, Kontaktzeit 60 h, Selbststudium 120 h
Lecture hours Kontaktzeit (SWS)	4
ECTS-Credit Points (CP) Kreditpunkte	6
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	-none-
Learning Objectives Angestrebte Lernergebnisse	<p>Factory Planning</p> <p>The lecture factory planning shows the state of the art of the particular topics. Best-practice methods and approaches are explained and reference solutions presented.</p> <p>After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding:</u></p> <p><i>Students</i></p> <ol style="list-style-type: none"> know and understand the main scope and challenges of factory planning projects. understand the basic principles and methods of the factory planning modules which are presented in the lectures goal definition & product/ process analysis, location planning & plant structure planning, industrial facility & building design, production structure planning & capacity planning, layout planning & workstation design, production logistics planning & production control, personnel planning & change management, implementation planning & ramp-up management and project management. <p><u>Abilities / Skills:</u></p> <p><i>Students</i></p>

	<ul style="list-style-type: none"> a) are able to apply the gained knowledge to assess different factory planning solutions in industrial practice. b) are able to develop own factory planning concepts of lower complexity within the presented modules. c) have the ability to solve factory planning problems independently. <p><u>Competences:</u> <i>Students</i></p> <ul style="list-style-type: none"> a) can participate in factory planning projects and collaborate with other planners. b) can cope with the high complexity in factory planning projects and are able to develop creative solutions.
<p>Content Inhalt</p>	<p>Factory Planning</p> <p>L1/L2 - Introduction Comprehending the basic glossary, getting to know the content and understanding the challenges and requirements of modern factory planning and learn about the Aachen Factory Planning Methodology.</p> <p>L3/L4 - Definition of goals and Product and process analysis Getting to know methods for the definition of goals in early planning phases. Comprehending basic methods for the analysis of product and processes.</p> <p>L5/L6 – Location planning and plant structure planning The lecture focusses on the basic criteria for the selection of a specific plant location and methods for the planning of the particular plant structure.</p> <p>L7/8 – Industrial facility and Building design Getting to know the basic processes within industrial facility and building design and learning about different building concepts.</p> <p>L9/10 - Production structure planning and Capacity planning Introduction to production structure planning with an explanation of different concepts, understanding methods for the quantitative planning of production capacities and resources.</p> <p>L11/12 - Layout planning and Workstation design Introduction to challenges and targets of layout planning and acquiring knowledge of design and assessment of factory layouts. Getting to know basic targets and methods for the design of single workstations.</p> <p>L13/L14 - Production logistics planning and Production control Comprehend the basics of logistics planning, getting to know the development of logistic strategies and principles from sourcing to recycling processes and learning about basic principles in production control.</p> <p>L15/16 - Personnel planning and change management Introduction to personnel planning with its specific challenges and methods, learning about problems and solution approaches within change management processes.</p> <p>L17/18 - Implementation planning and ramp-up management Getting to know basic methods of implementation planning and understanding challenges within the ramp-up of new products. Learning about tools and methods within ramp-up management.</p> <p>L19/20 - Project management</p>

	Understanding basic methods and principles within project management for the project planning and project execution & controlling.					
Media Medienform	e-Learning L ² P, Power Point					
Literature Literatur						
Lectures / Examinations Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kreditpunkte	Workload Arbeitsaufwand (h)	Lecture H. Kontaktzeit (h)	Self-study Selbststudium (h)	Duration of Exam Prüfungsdauer (min)
Examination (Prüfung): Factory Planning	MSPSE	6	0	0	0	90
Lecture (Vorlesung): Factory Planning	MSPSE	0	90	30	60	
Exercise (Übung): Factory Planning	MSPSE	0	90	30	60	
Teaching / Examinations: Examination Factory Planning Studien-/Prüfungsleistung: Prüfung Factory Planning						
Title Titel	Examination Factory Planning Prüfung Factory Planning					
Sub-title Untertitel	FP					
Semester Studiensemester	1					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					
Teaching / Examinations: Lecture Factory Planning Studien-/Prüfungsleistung: Vorlesung Factory Planning						
Title Titel	Lecture Factory Planning Vorlesung Factory Planning					
Sub-title Untertitel	V FP					
Semester Studiensemester	1					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					
Teaching / Examinations: Examination Factory Planning Studien-/Prüfungsleistung: Übung Factory Planning						
Title Titel	Exercise Factory Planning <u>Übung</u> Factory Planning					
Sub-title Untertitel	U FP					
Semester Studiensemester	1					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					

Module (Modul): Modeling, Model Reduction and Simulation in Laser Processing I

Module Modulbezeichnung	Modeling, Model Reduction and Simulation in Laser Processing I
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	MMRSLP I
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	2
Person in Charge Modulverantwortliche	Schulz, Wolfgang
Lecturer Dozenten	Schulz, Wolfgang
Language Sprache	English Englisch
Assignment to the curriculum Zuordnung zum Curriculum	Elective module Semestervariable Wahlpflichtleistung
Teaching form Lehrformen	Written examination, Lecture, Exercise Klausur (KI), Vorlesung (V), Übung (Ü)
Workload Arbeitsaufwand	Total 150h, Contact hours 60h, Self-study 90h Gesamt 150h, Kontaktzeit 60h, Selbststudium 90h
Lecture hours Kontaktzeit (SWS)	4
ECTS-Credit Points (CP) Kreditpunkte	5
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	-none-
Learning Objectives Angestrebte Lernergebnisse	<p>Modeling, Model Reduction and Simulation in Laser Processing I</p> <p>After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding:</u></p> <ol style="list-style-type: none"> a) experimental evidence of Maxwell equations b) refraction, diffraction and scattering, Fresnel- number N_i, and applications c) can perform the derivation of SVE-approximation d) Laser light, can perform the calculation imaging and focussing e) know at least 3 types of laser systems, temporal and spatial distribution of laser radiation, Fresnel-number, invariant quantity of light propagation f) understand the structure of solution for the Helmholtz-equation, diffraction, 5 parameter pairs of optical material equations, transmission, reflection, absorption, Fresnel Formulae, polarisation of matter and radiation g) know the main properties of the solution in the asymptotic case of paraxial light propagation and can explain the relation between optical and material parameters

	<p>h) know the effect of coupling between atoms and can explain the relation between band structure and optical properties</p> <p>i) understand the interactive cooperation of scientists from engineering, physics and mathematics for application of model based methods for diagnosis in laser processing</p> <p><u>Abilities / Skills:</u></p> <p>j) Application of model based methods for solving practical tasks of laser design from discussion of project examples</p>					
Content Inhalt	<p>Modeling, Model Reduction and Simulation in Laser Processing I</p> <p>Overview of contents, definition of the 10 learning targets</p> <ul style="list-style-type: none"> the contribution of the engineer to the interactive cooperation of scientific disciplines main features of the theory of cognition (Karl Popper) Light: <ul style="list-style-type: none"> amplitude and phase, Fermat's principle, laser radiation, Helmholtz equation, diffraction, Fresnel- number N_f, reduced model: SVE-approximation Learning target 1: experimental origin of Maxwell equations, Rayleigh scattering, Laser Principle Learning target 2: ABCD-matrix, ABCD-law Learning target 3: <ul style="list-style-type: none"> beam parameter product, optical invariant Matter: <ul style="list-style-type: none"> emission spectra, band structure, reflection, transmission and absorption of light, Learning target 4: isolator, semiconductor, metal, gas Learning target 5: Rydberg constant, Planck's law Learning target 6: reduced model of the Fresnel Formulae for the limiting case of small displacement current, optical parameters Gaussian Beam: <ul style="list-style-type: none"> beam quality, beam guiding and forming Learning target 7: quality features of light, Plane-, spherical- and Gouy-phase Quality number K and focussing F-number Resonator: <ul style="list-style-type: none"> frequency filter, axial mode structure Learning target 8: feedback-axial mode structure, g-parameter, aperture-lateral mode, Fresnel number N_f, rod and tube design Active Medium: <ul style="list-style-type: none"> entropy, phase transition of 2. Kind, Einstein rate equations Learning target 9: Gas and Solid-state and Diode Laser Learning target 10: laser threshold, cooling, pumping Modulation: <ul style="list-style-type: none"> Gain switch μs, Q-Switch ns, Mode locking fs Learning target 11: phase coupling concluding discussion of the learning targets actual research and development of laser processing 					
Media Medienform	e-Learning L ² P, Power Point					
Literature Literatur						
Lectures / Examinations Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kredit- punkte	Workload Arbeits- aufwand (h)	Lecture H. Kontakt- zeit (h)	Self-study Selbst- studium (h)	Duration of Exam Prüfungs- dauer (min)
Examination (Prüfung): Modeling, Model Reduction and Simulation in Laser Processing I	MSPSE	5	0	0	0	120

Lecture (Vorlesung): Modeling, Model Reduction and Simulation in Laser Processing I	MSPSE	0	75	30	45	
Exercise (Übung): Modeling, Model Reduction and Simulation in Laser Processing I	MSPSE	0	75	30	45	
Teaching Unit / Examinations: Examination Modeling, Model Reduction and Simulation in Laser Processing I Studien-/Prüfungsleistung: Prüfung Modeling, Model Reduction and Simulation in Laser Processing I						
Title Titel	Examination Modeling, Model Reduction and Simulation in Laser Processing I Prüfung Modeling, Model Reduction and Simulation in Laser Processing I					
Sub-title Untertitel	MMRSLP I					
Semester Studiensemester	2					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					
Teaching Unit / Examinations: Lecture Modeling, Model Reduction and Simulation in Laser Processing I Studien-/Prüfungsleistung: Vorlesung Modeling, Model Reduction and Simulation in Laser Processing I						
Title Titel	Lecture Modeling, Model Reduction and Simulation in Laser Processing I Vorlesung Modeling, Model Reduction and Simulation in Laser Processing I					
Sub-title Untertitel	V MMRSLP I					
Semester Studiensemester	2					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					
Teaching Unit / Examinations: Exercise Modeling, Model Reduction and Simulation in Laser Processing I Studien-/Prüfungsleistung: Übung Modeling, Model Reduction and Simulation in Laser Processing I						
Title Titel	Exercise Modeling, Model Reduction and Simulation in Laser Processing I Übung Modeling, Model Reduction and Simulation in Laser Processing I					
Sub-title Untertitel	Ü MMRSLP I					
Semester Studiensemester	2					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					

Module (Modul): Modeling, Model Reduction and Simulation in Laser Processing II

Module Modulbezeichnung	Modeling, Model Reduction and Simulation in Laser Processing I&II
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	MMRSLP II
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	1
Person in Charge Modulverantwortliche	Schulz, Wolfgang
Lecturer Dozenten	Schulz, Wolfgang
Language Sprache	English Englisch
Assignment to the curriculum Zuordnung zum Curriculum	Elective module Semestervariable Wahlpflichtleistung
Teaching form Lehrformen	Written examination, Lecture, Exercise Klausur (KI), Vorlesung (V), Übung (Ü)
Workload Arbeitsaufwand	Total 150h, Contact hours 60h, Self-study 90h Gesamt 150h, Kontaktzeit 60h, Selbststudium 90h
Lecture hours Kontaktzeit (SWS)	4
ECTS-Credit Points (CP) Kreditpunkte	5
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	-none-
Learning Objectives Angestrebte Lernergebnisse	<p>Modeling, Model Reduction and Simulation in Laser Processing II</p> <p>After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding:</u></p> <ul style="list-style-type: none"> a) Free Boundary Problems and integral methods of solution, b) non-linear stability analysis using spectral methods, c) analysis of the structural stability of model equations and d) 5 parameter pairs of optical material equations, transmission, reflection, absorption, Fresnel Formulae, polarisation of matter and radiation <p>Learning target 2: optical parameters</p> <ul style="list-style-type: none"> e) Slow surfaces in dynamical Systems: applications for separation of time scales <p>Learning target 6: Thermal effect of large and small Peclet-number,</p>

	<p>f) know and understand the 5 different, dominant phenomena of drilling, welding and cutting with laser radiation</p> <p>Learning target 5: quality features</p> <p>g) know the physical meaning of the terms contained in the Navier-Stokes equations for mass, momentum, and energy balance</p> <p>h) know the main properties of the solution in the asymptotic case of thin film flow (boundary layer) and can explain the relation between dynamical properties of the solution and quality features of the product as well as productivity of the process for drilling and cutting</p> <p>i) know the effect of dissipation in distributed dynamical systems (inertial manifold) and know examples for the application of methods for the reduction of the dimension in dissipative systems, understand and perform the separation of length and time scales in simple systems</p> <p>Learning target 7: heating and melting phase of ablation</p> <p>j) understand the interactive cooperation of scientists from engineering, physics and mathematics for application of model based methods for diagnosis in laser processing</p> <p>Lerning target 8: reduced modeling</p> <p><u>Abilities / Skills:</u></p> <p>a) Application of model based methods for solving practical tasks from discussion of project examples</p>
<p>Content Inhalt</p>	<p>Modeling, Model Reduction and Simulation in Laser Processing II</p> <p>Overview of contents, definition of the 10 learning targets</p> <ul style="list-style-type: none"> • the contribution of the engineer to the interactive cooperation of scientific disciplines • main features of the theory of cognition (Karl Popper) • recapitulation of the 10 learning targets from Module I: Laser • Learning target 1: at least 10 industrial applications of laser radiation • Learning target 2: reduced model of the Fresnel Formulae for the limiting case of small displacement current, optical parameters • technical task and examples: cutting with laser radiation • Learning target 3: quality features of the high quality cut • physical task of cutting and identification of quality defined processing domains • Learning target 4: relation of physical phenomena to the built up of quality degradations • technical task and examples: drilling with laser radiation • physical task formulation and 5 dominant phenomena • Learning target 5: quality features of the drilled hole • mathematical modelling Ia: length and time scales • degrees of freedom in phase space of dependent variables • separation of time scales in simple dynamical systems • Learning target 6a: separation of time scales • mathematical modelling Ib: singular perturbation and asymptotic expansion • thermal boundary layer in heat conduction with moving boundaries • Learning target 6b: separation of length scales • mathematical modelling II: Free Boundary Problems (FBP) for the solid phase • reduced model for the FBP : motion of the melting front, integral methods, variational formulation • Learning target 7: heating and melting phase of ablation • mathematical modelling III: Meta-Modeling Morse-Smale-Complex • Lerning target 8: reduced model of drilling and cutting • mathematical model reduction: melt flow

	<ul style="list-style-type: none"> reduced model for thin film flow Learning target 9: ripple and dross formation in cutting model reduction and solution with controlled error: melt flow at low Reynolds-number structural stability of the reduced model: lubrication approximation, fingering and droplet formation global properties of the solution of balance equations for mass, momentum and thermal energy – example: cutting Learning target 10: scales for parameter estimation in laser processing parameters in cutting and drilling concluding discussion of the learning targets actual research and development of laser processing 					
Media Medienform	e-Learning L ² P, Power Point					
Literature Literatur						
Lectures / Examinations Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kreditpunkte	Workload Arbeitsaufwand (h)	Lecture H. Kontaktzeit (h)	Self-study Selbststudium (h)	Duration of Exam Prüfungsdauer (min)
Examination (Prüfung): Modeling, Model Reduction and Simulation in Laser Processing II	MSPSE	5	0	0	0	120
Lecture (Vorlesung): Modeling, Model Reduction and Simulation in Laser Processing II	MSPSE	0	75	30	45	
Exercise (Übung): Modeling, Model Reduction and Simulation in Laser Processing II	MSPSE	0	75	30	45	
Teaching Unit / Examinations: Examination Modeling, Model Reduction and Simulation in Laser Processing II Studien-/Prüfungsleistung: Prüfung Modeling, Model Reduction and Simulation in Laser Processing II						
Title Titel	Examination Modeling, Model Reduction and Simulation in Laser Processing II Prüfung Modeling, Model Reduction and Simulation in Laser Processing II					
Sub-title Untertitel	MMRSLP II					
Semester Studiensemester	1					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					
Teaching Unit / Examinations: Lecture Modeling, Model Reduction and Simulation in Laser Processing II Studien-/Prüfungsleistung: Vorlesung Modeling, Model Reduction and Simulation in Laser Processing II						
Title Titel	Lecture Modeling, Model Reduction and Simulation in Laser Processing II Vorlesung Modeling, Model Reduction and Simulation in Laser Processing II					
Sub-title Untertitel	V MMRSLP II					
Semester Studiensemester	1					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					

Teaching Unit / Examinations: Exercise Modeling, Model Reduction and Simulation in Laser Processing II	
Studien-/Prüfungsleistung: Übung Modeling, Model Reduction and Simulation in Laser Processing II	
Title Titel	Exercise Modeling, Model Reduction and Simulation in Laser Processing II Übung Modeling, Model Reduction and Simulation in Laser Processing II
Sub-title Untertitel	Ü MMRSLP II
Semester Studiensemester	1
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung

Module (Modul): Advanced Software Engineering

Module Modulbezeichnung	Advanced Software Engineering
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	ASE
Lecture Lehrveranstaltungen	Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	2
Person in Charge Modulverantwortliche	Jeschke, Sabina
Lecturer Dozenten	Jeschke, Sabina
Language Sprache	English Englisch
Assignment to the curriculum Zuordnung zum Curriculum	Elective module Semestervariable Wahlpflichtleistung
Teaching form Lehrformen	Written examination, Lecture, Exercise Klausur (KI), Vorlesung (V), Übung (Ü)
Workload Arbeitsaufwand	Total 150h, Contact hour 60h, Self-study 90h Gesamt 150 h, Kontaktzeit 60 h, Selbststudium 90 h
Lecture hours Kontaktzeit (SWS)	4
ECTS-Credit Points (CP) Kreditpunkte	5
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	-none-
Learning Objectives Angestrebte Lernergebnisse	<p>Advanced Software Engineering</p> <p>After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding:</u></p> <ul style="list-style-type: none"> a) They comprehend for what purposes, under which conditions and with which consequences computer systems are used for the solution of problems related to Mechanical Engineering. b) They gain a solid knowledge in the Software Development Life Cycle and the main activities and core concepts under each software development phase. <p><u>Abilities / Skills:</u></p> <ul style="list-style-type: none"> a) They have the ability to transfer the acquired knowledge in object oriented design to different engineering problems and understand the general structure and the functionality of software.
Content	

Inhalt	Advanced Software Engineering					
	<p>The aim of the course is to explain students for what purposes, under which conditions and with which consequences computer systems are used for the solution of problems related to Mechanical Engineering.</p> <p>Within the first part of the course the steps from problem description to the final software solution are illustrated. This covers the topics modelling, problem elicitation and analysis, program design and an introduction to UML (Unified Modelling Language). Then the course goes on with a closer examination of the various aspects which comprise software development, concerning with topics like design patterns, agile software processes and project management. Parallel to the lecture the students are given the chance to employ the theoretical input from the course in small software projects. After an introduction to the basics of Java and object-oriented programming, the students stepwise pass through the particular stages of a software development process. Moreover, a part of the exercise is implemented by using physical robots.</p>					
Media Medienform	e-Learning L2P, Power Point					
Literature Literatur	Recommended: • Basic knowledge in a programming language (e.g. C, C++)					
Lectures / Examinations						
Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kredit- punkte	Workload Arbeits- aufwand (h)	Lecture H. Kontakt- zeit (h)	Self-study Selbst- studium (h)	Duration of Exam Prüfungs- dauer (min)
Examination (Prüfung): Advanced Software Engineering	MSPSE	5	0	0	0	120
Lecture (Vorlesung): Advanced Software Engineering	MSPSE	0	75	30	45	
Exercise (Übung): Advanced Software Engineering	MSPSE	0	75	30	45	
Teaching Unit / Examinations: Examination Advanced Software Engineering						
Studien-/Prüfungsleistung: Prüfung Advanced Software Engineering						
Title Titel	Examination Software Engineering Prüfung Advanced Software Engineering					
Sub-title Untertitel	ASE					
Semester Studiensemester	2					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					
Teaching Unit / Examinations: Lecture Advanced Software Engineering						
Studien-/Prüfungsleistung: Vorlesung Advanced Software Engineering						
Title Titel	Lecture Software Engineering Vorlesung Advanced Software Engineering					
Sub-title Untertitel	V ASE					
Semester Studiensemester	2					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					
Teaching Unit / Examinations: Exercise Advanced Software Engineering						
Studien-/Prüfungsleistung: Übung Advanced Software Engineering						

Title Titel	Exercise Software Engineering Übung Advanced Software Engineering
Sub-title Untertitel	Ü ASE
Semester Studiensemester	2
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung

Module (Modul): Tribology

Module Modulbezeichnung	Tribology
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	TB
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	2
Person in Charge Modulverantwortliche	Jacobs, Georg
Lecturer Dozenten	Jacobs, Georg
Language Sprache	English Englisch
Assignment to the curriculum Zuordnung zum Curriculum	Elective module Semestervariable Wahlpflichtleistung
Teaching form Lehrformen	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload Arbeitsaufwand	Total 150h, Contact hour 60h, Self-study 90h Gesamt 150 h, Kontaktzeit 60 h, Selbststudium 90 h
Lecture hours Kontaktzeit (SWS)	4
ECTS-Credit Points (CP) Kreditpunkte	5
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	-none-
Learning Objectives Angestrebte Lernergebnisse	<p>Tribology</p> <p>After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding:</u></p> <p><i>Students</i></p> <p>a) know fundamental mechanisms in the contact zone of tribosystems:</p> <ul style="list-style-type: none"> - hydrodynamics - material deformation - tribological stress - fluid / solid body friction - wear <p><u>Abilities / Skills:</u></p> <p><i>Students</i></p> <p>a) are able to employ the fundamental theories to design and analyze tribosystems.</p> <p>b) are able to desgin tribosystems in mechanical systems, like journal bearings, roller bearings, gear wheels and seals.</p>

	<p><u>Competences:</u> <i>Students</i></p> <ul style="list-style-type: none"> a) are theoretically capable of choosing and applying different suitable measuring- and test systems to investigate the tribosystems of journal bearings, roller bearings, gear wheels and seals. b) are capable of choosing and applying different suitable calculation and simulation methods to investigate the tribosystems of journal bearings, roller bearings, gear wheels and seals. c) are capable of estimating the quality of the tribosystem according to the test and simulation results and to optimize it with the background knowledge of a considerably large action catalogue. d) are able to design the tribosystems of the mechanical components of drive trains. e) are able to minimize friction and wear in mechanical drive trains. In that way, they can enhance the resource and energy efficiency of drive train systems.
<p>Content Inhalt</p>	<p>Tribology</p> <p><u>Basics of tribology:</u></p> <ul style="list-style-type: none"> • Tribosystem in general and its analysis • Wear and friction processes • Test methods <p><u>Interactions between base and contact bodies:</u></p> <ul style="list-style-type: none"> • Contact processes and geometries, material strain, Hertzian theory, contact mechanics • Frictional processes and the results and influence on the tribosystem, wear processes and methods to avoid wear and losses <p><u>Properties of base and contact bodies:</u></p> <ul style="list-style-type: none"> • Tribomaterials and the analysis of technical surfaces, roughness, hardness definitions and test methods • Coating types and methods and their technical application, systematical methods and examples for the correct choice of material <p><u>Properties of intermediate medium:</u></p> <ul style="list-style-type: none"> • Basic properties, dependencies and test methods for the viscosity • Classification, properties and application examples for different lubricants (oils, greases and solid lubricants) <p><u>Basics of hydrodynamics and elasto-hydrodynamics:</u></p> <ul style="list-style-type: none"> • Fundamentals and principles of flow mechanisms, derivation of Navier-Stokes and Reynolds equations and continuity equation • Application of the hydrodynamic equations regarding the calculation of bearings • Basics of the elasto-hydrodynamics <p><u>Tribosystem journal bearings:</u></p> <ul style="list-style-type: none"> • Functionality and calculation of hydrodynamic axial and radial journal bearings • Damages and failures of hydrodynamic journal bearings • Choice of suitable lubricants for hydrodynamic journal bearings • Functionality and calculation of hydrostatic axial and radial journal bearings • Damages and failures of hydrostatic journal bearings • Choice of suitable lubricants for hydrostatic journal bearings <p><u>Tribosystem gear wheels:</u></p> <ul style="list-style-type: none"> • Lubricants and materials for gears and their influence and application • Application of the EHD-theory for gear stages • Damages and failures of gear wheels and suitable test methods for the analysis of gear stages <p><u>Tribosystem roller bearings:</u></p> <ul style="list-style-type: none"> • Design, materials and lubrication for roller bearings • Friction, damages and failures for roller bearings • Test methods for the analysis of roller bearings <p><u>Tribosystem seals:</u></p> <ul style="list-style-type: none"> • Different types and designs of seals

	<ul style="list-style-type: none"> • Specialties and application of different seals • Materials for seals 					
Media Medienform	e-Learning L2P, Power Point					
Literature Literatur						
Lectures / Examinations Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kreditpunkte	Workload Arbeitsaufwand (h)	Lecture H. Kontaktzeit (h)	Self-study Selbststudium (h)	Duration of Exam Prüfungsdauer (min)
Examination (Prüfung): Tribology	MSPSE	5	0	0	0	120
Lecture (Vorlesung): Tribology	MSPSE	0	75	30	45	
Exercise (Übung): Tribology	MSPSE	0	75	30	45	
Teaching Unit / Examinations: Examination Tribology Studien-/Prüfungsleistung: Prüfung Tribology						
Title Titel	Examination Tribology Prüfung Tribology					
Sub-title Untertitel	TB					
Semester Studiensemester	2					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					
Teaching Unit / Examinations: Lecture Tribology Studien-/Prüfungsleistung: Vorlesung Tribology						
Title Titel	Lecture Tribology Vorlesung Tribology					
Sub-title Untertitel	V TB					
Semester Studiensemester	2					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					
Teaching Unit / Examinations: Exercise Tribology Studien-/Prüfungsleistung: Übung Tribology						
Title Titel	Exercise Tribology Übung Tribology					
Sub-title Untertitel	Ü TB					
Semester Studiensemester	2					
Connection to the curriculum Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					

Module (Modul): Machine Design Process

Module Modulbezeichnung	Machine Design Process
Modul level Modulniveau	
Code Kürzel	MSPSE
Subtitle Untertitel	MDP
Lecture Lehrveranstaltungen	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester Studiensemester	2
Person in Charge Modulverantwortliche	Feldhusen, Jörg
Lecturer Dozenten	Feldhusen, Jörg
Language Sprache	English Englisch
Assignment to the curriculum Zuordnung zum Curriculum	Elective module Semestervariable Wahlpflichtleistung
Teaching form Lehrformen	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload Arbeitsaufwand	Total 150h, Contact hour 60h, Self-study 90h Gesamt 150 h, Kontaktzeit 60 h, Selbststudium 90 h
Lecture hours Kontaktzeit (SWS)	4
ECTS-Credit Points (CP) Kreditpunkte	5
Requierments according to examination regulation Voraussetzungen nach Prüfungsordnungen	None
Learning Objectives Angestrebte Lernergebnisse	<p>Machine Design Process and Practical Applications of Computer- Aided Engineering Tools</p> <p>After successfully completing this course, the student will have acquired the following learning outcomes:</p> <p><u>Knowledge / Understanding:</u> Students</p> <ol style="list-style-type: none"> know the most common machine elements and applicable design rules, standards and understand production drawings including dimensions and tolerances. know structured problem solving strategies, esp. the engineering design process acc. to VDI 2221. know the structure and some examples of the body of design rules <p><u>Competencies:</u> Students</p> <ol style="list-style-type: none"> are able to analyse and design mechanical systems using common machine elements through the ability to read and understand as well as draft assembly drawings according to ISO drawing standards and define the production

	<p>specifications on machined parts through the ability of drafting production drawings according to ISO drawing standards.</p> <p>e) are able to identify possible restrictions on a design task and to develop and select applicable concept solutions with a systematic approach.</p> <p>f) are able to assess the applicability of design rules depending on effective design restrictions. Basic rules of embodiment design, design principles and guidelines are applied to draw up technical drafts.</p>
<p>Content Inhalt</p>	<p>Machine Design Process</p> <p>Topic: Introduction</p> <p>Topic: Drawing Standards I</p> <ul style="list-style-type: none"> • Projection drawing and axonometric views • Elements of technical drawings • Dimensioning <p>Topic: Drawing Standards II</p> <ul style="list-style-type: none"> • Section views • Broken views <p>Topic: Joins and Connections</p> <ul style="list-style-type: none"> • Connection types • Bolted connections • Shaft and hub connections <p>Topic: Geometrical Irregularities and Tolerances</p> <ul style="list-style-type: none"> • Dimension tolerances • Form and position tolerances • Technical surfaces <p>Topic: Bearing of Shafts</p> <ul style="list-style-type: none"> • Bearing principles • Bearing arrangements • Seals <p>Topic: Power Transmission</p> <ul style="list-style-type: none"> • Definitions and principles • Technical representation • Examples <p>Topic: Engineering Design Process, Requirements List</p> <ul style="list-style-type: none"> • Introduction to design methodology • General process of engineering design • Requirements list <p>Topic: Conceptual Design I</p> <ul style="list-style-type: none"> • Function structures and principle solutions • Design catalogues • Heuristic and analogy methods <p>Topic: Conceptual Design II</p> <ul style="list-style-type: none"> • Systematic variation, classification schemes • Overall solutions: morphological matrix <p>Topic: Design Rules I - Basic Rules</p> <ul style="list-style-type: none"> • Introduction to design rules • Basic rules 'simple' and 'clear' • Basic rule 'safe'

	<p>Topic: Design Rules II - Principles</p> <ul style="list-style-type: none"> Principles of fault-free design, force transmission, stability and bi-stability, self-help, division of tasks <p>Topic: Design Rules III – Guidelines / DFX</p> <ul style="list-style-type: none"> Selected examples: design for assembly and production... 					
Media Medienform	e-Learning L2P, Power Point					
Literature Literatur						
Lectures / Examinations Studien-/Prüfungsleistungen						
Title Titel	Code Kürzel	ECTS Kreditpunkte	Workload Arbeitsaufwand (h)	Lecture H. Kontaktzeit (h)	Self-study Selbststudium (h)	Duration of Exam Prüfungsdauer (min)
Examination (Prüfung): Machine Design Process	MSPSE	5	0	0	0	120
Lecture (Vorlesung): Machine Design Process	MSPSE	0	75	60	45	
Exercise (Übung): Machine Design Process	MSPSE	0	75	60	45	
Teaching Unit / Examinations: Examination Machine Design Process Studien-/Prüfungsleistung: Prüfung Machine Design Process						
Titel	Examination Machine Design Process Prüfung Machine Design Process					
Untertitel	MDP					
Studiensemester	2					
Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					
Teaching Unit / Examinations: Lecture Machine Design Process Studien-/Prüfungsleistung: Vorlesung Machine Design Process						
Titel	Lecture Machine Design Process Vorlesung Machine Design Process					
Untertitel	V MDP					
Studiensemester	2					
Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					
Teaching Unit / Examinations: Exercise Machine Design Process Studien-/Prüfungsleistung: Übung Machine Design Process						
Titel	Exercise Machine Design Process Übung Machine Design Process					
Untertitel	Ü MDP					
Studiensemester	2					
Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung					